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FY 2011 CSC FUNDED PROJECTS

ALASKA

Development and Application of an Integrated Ecosystem Model (IEM) for Alaska

Principal Investigator: **David McGuire**, University of Alaska, Fairbanks (UAF)
Co-investigators: **T. Scott Rupp**, UAF; **Vladimir Romanovsky**, UAF; **Eugenie Euskirchen**, UAF; Sergey Marchenko, UAF

Ongoing climate change throughout Alaska has the potential to affect terrestrial ecosystems and the services that they provide to the people of Alaska and the nation. These services include the provisioning of food and fiber by Alaskan ecosystems, the importance of ecosystems to recreation, cultural, and spiritual activities of people in Alaska, and the role Alaska ecosystems play in regulating the climate system. Assessments of the effects of climate change on ecosystem services has in part been hindered by the lack of tools capable of forecasting how landscape structure and function might change in response to climate change. In Alaska, such tools need to consider how ecological processes play out in both space and time. Landscapes may change substantially in time and space because of shifting composition of species dominance (e.g., an increase of shrubs in tundra) and species migration (e.g., treeline advance). These shifts in landscape structure and function may be caused by changes in disturbance regimes (e.g., fire, insects, wind throw), permafrost integrity, and hydrology across the landscape. In this study, we propose to develop and apply an ecosystem model for Alaska that is capable of forecasting how landscape structure and function might change in response to how climate change influences interactions among disturbance regimes, permafrost integrity, hydrology, vegetation succession, and vegetation migration. This tool would provide scenarios of changes in landscape structure and function that could be used by resource-specific impact models to assess the effects of climate change on specific natural resources.

Detection of Climate-linked distributional shifts of breeding water birds across North America

Principal Investigator: **Joel Schmutz**, USGS Alaska Science Center
Cooperators & Partners: **Jim Nichols**, Patuxent Wildlife Research Center; **Mark Lindberg**, University of Alaska Fairbanks; **Dave Verbyla**, University of Alaska, Fairbanks; **Mark Koneff**, U.S. Fish and Wildlife Service

Extensive and long-term sampling is necessary to identify demographically important changes in the distribution of wildlife populations that may be linked to climate processes. Few survey data streams exist for such an assessment. The Waterfowl Breeding Population and Habitat Survey is one notable exception to this limitation. This survey, conducted annually through the leadership of the Division of Migratory Bird Management of the U.S. Fish and Wildlife Service, samples 5 million square kilometers and covers prairies, parklands, boreal forest, and coastal habitats Additional surveys similarly cover tundra areas of the US and Canada. Data from these surveys are used annually in an adaptive management and decision framework that provides objective model output for how harvest regulations across the continent should be implemented to maintain existing populations. Researchers for this project will estimate rates of species colonization or extinction (i.e., 'occupancy') using a spatially and temporally explicit model. The relationship between occupancy and habitat and climate covariates will also be modeled. These analyses will identify how species distributions of waterbirds for much of the

continent are responding to climate processes. Results from this project could affect monitoring design and the adaptive harvest management (AHM) process in several ways. One outcome may be a recommendation to eliminate some survey segments or strata or add in new ones. A second possibility is that the underlying demographic model structures that drive the adaptive management decision models may need to be modified to include progressive environmental change that is ultimately driven by climate. Results and how they will impact future surveys and AHM will be presented both in publications and in meetings, including presentations at conferences, flyway meetings, and other appropriate venues. Researchers will work closely through all phases of this project with U.S. Fish and Wildlife Service colleagues. Additionally, we will partner with the University of Alaska.

Ecology, Soil Carbon, and Permafrost Experiments (ECOSCAPE)

Principal Investigator: **Mark Waldrop**, USGS

Model parameterization, validation, and verification are important aspects of model development and improving model prediction. As such, this research project has been structured to address the most important data needs of the Integrated Ecosystem Model (IEM) project, and will be modified as future needs arise. Currently, the goal of the IEM is to develop a modeling framework that integrates vegetation succession, disturbance, hydrology, and permafrost dynamics using ALFRESCO, TEM, and GIPL models. Model output will also be tested or verified through field investigations in future years. The proposed research builds upon already existing infrastructure for studying ecosystem biogeochemistry in the Yukon River Basin (YRB) and the Alaska Peatland Experiment (APEX) by USGS and its partners. The goal of this project is to conduct field studies to support the parameterization, validation, and verification of Integrated Ecosystem Models using established and ongoing field investigations of vegetation succession, soil C & N storage and fluxes, climate, and permafrost characteristics in the YRB and APEX.

Assessing the Sensitivity of Alaska's Coastal Rainforest Ecosystem to Changes in Glacier Runoff

Principal Investigator: **Shad O'Neel**, USGS Alaska Science Center; **Anthony Arendt**, Geophysical Institute, University of Alaska, Fairbanks; **Eran Hood**, University of Alaska Southeast; **Sanjay Pyare**, University of Alaska Southeast

Methods to quantify runoff from watersheds along the Gulf of Alaska will be developed, allowing an assessment of impacts on the coastal ecosystems, from both a physical and biogeochemical standpoint. This study will assess available data, develop an interdisciplinary conceptual model and disseminate findings to both scientific peers and the public, paving the way forward to a better understanding of one of least understood regional hydrological cycles on Earth. New information from this study will provide a framework for assessing the future evolution of glacier discharge into the Gulf of Alaska, reducing uncertainty in determining the response of coastal ecosystems to changing climate.

Integrating Studies of Glacier Dynamics and Estuarine Chemistry in the context of Landscape Change in the Arctic

Principal Investigator: **Matt Nolan**, University of Alaska, Fairbanks, Institute of Northern Engineering
Co-Investigators: **Jim McClelland**, University of Texas; **Ken Dunton**, University of Texas

The overarching research questions for this project are: (1) How much of the river water and water-borne constituents (i.e. sediment, nutrients, organic matter) from the Jago, Okpilak and Hulahula rivers are coming from glacier melt? (2) How do these glacier inputs affect terrestrial, aquatic, and coastal ecosystems? (3) How is this likely to change as the glaciers disappear? This project will help elucidate how inputs from glacier-dominated arctic rivers differ from unglaciated rivers by studying both types of systems from the ground, air and water. This, in turn, would improve our ability to think about and plan for potential changes in downstream ecosystem responses that may be different from region to region along the Arctic Ocean coast.

NORTH CENTRAL

North Central Climate Impacts and Response Research and Assessment: End-to-End Information Storage, Analysis, and Access Capacity Pilot Study

Principal Investigator(s): **Dennis Ojima**, Colorado State University; **Jay Hestbeck**, USGS

Colorado State University will coordinate and involve federal, state, tribal, and university partners to implement a pilot study to develop data and information exchange protocols, analytical needs across a distributed network and platform specific computing capabilities. This pilot study will be organized around a set of specific management questions from our partner community. Issues related to species, landscape, ecosystem natural resource connections will be used to orient the pilot study across various scales of decision making. Considerations of various security and access issues for the user community will be evaluated and guidelines will be developed. Based on the workshop recommendations a set of data, modeling, analysis, and information exchange pilot study will be undertaken to evaluate the current capacity and projected capacity to analyze, archive, and distribute information across various IT infrastructure types. The outcome of the pilot study will be an assessment report of the capability and constraints to analysis and information exchange between federal and non-federal installations, including public access to climate-relevant information. Pilot Study components include: 1) downscaling of climate projections; 2) ecosystem, habitat, and wildlife modeling capacity; and 3) adaptive management. CSU will develop an innovative platform for user-friendly information exchange, distributed analysis platform (e.g., cloud computing), inter-operable data and analysis interface, and supporting various decision-support systems that provide dramatically new views of data critical to supporting producers, decision-makers and researchers in analyzing climate-associated risk events and mitigating their effects.

Collaborative Modeling Approaches for Climate and Landscape Planning in the Northern Rockies: Exploring FRAME-SIMPPLLE

Principal Investigator(s): **Cathy L. Whitlock**, Montana State University; **Kathryn M. Irvine**, U.S. Geological Survey, Northern Rocky Mountain Science Center; **Erik Beever**, U.S. Geological Survey, Northern Rocky Mountain Science Center; **Natasha B Carr**, U.S. Geological Survey, Fort Collins Science Center; **Carl D Shapiro**, Science and Decision Center, U.S. Geological Survey; **Jimmie Chew**, Rocky Mountain Research Station, U.S. Forest Service; **Richard S Sojda**, U.S. Geological Survey, Northern Rocky Mountain Science Center

Federal land managers need an adaptive management framework to accommodate changing conditions and that allow them to effectively link the appropriate science to natural resource management decision-making across jurisdictional boundaries. FRAME-SIMPPLLE is a collaborative modeling process designed to accomplish that goal by coupling the adaptive capabilities of the SIMPPLLE modeling system with accepted principles of collaboration. The two essential components of the process are FRAME (Framing Research in support of the Adaptive Management of Ecosystems), which creates a collaborative problem-solving environment, and SIMPPLLE (SIMulating Patterns and Processes at Landscape Scales), a vegetation dynamics modeling system. The resulting collaborative modeling process allows decision makers to optimize the management of multiple resources and evaluate the likely outcome of various choices. The approach is to collaboratively engage the resource managers, modelers, and scientists in framing the science issues embedded in key natural resource management issues and then developing the SIMPPLLE modeling approach to address those issues. Through a prototype collaborative modeling effort at Mesa Verde National Park, a process has been developed for adaptive, multi-objective resource management. Needed now is an effort to refine the approach and establish a transportable methodology that is applicable across a wide range of ecosystems. In the Northern Rockies, managers have expressed an interest in exploring this approach at Glacier National Park, the Crown of the Continent Ecosystem, and the Rocky Mountain Front.

North Central Climate Impacts and Response Research and Assessment: Data Integration Workshop

Principal Investigator(s): **Dennis Ojima**, Colorado State University; **Jay Hestbeck**, USGS

Colorado State University will organize and host a workshop to develop an information technology framework for data Integration for climate change impacts of ecosystem and landscape conservation. This workshop will include key DOI, federal and state agency partners, tribal governments and Universities. The objective is to develop a strategy for Information Technology framework to handle the various data, information, and computational services which the Climate Science Centers will be responsible to deliver. Particular attention will be paid to Landscape Conservation Cooperative needs related to climate and impact information. The workshop will cover issues related to distributed computing and data storage; information security issues across federal, state, university, and public portals; analysis across multiple scales and domains or sectors; information exchange to multiple user communities. The workshop will be charged to develop this framework which will serve Regional Climate Science Center's needs which include local to regional, cross-regional, and national level considerations.

North Central Climate Impacts and Response Research and Assessment: Regional Assessment
Principal Investigator(s): **Dennis Ojima**, Colorado State University; **Jay Hestbeck**, USGS

Colorado State University will coordinate with Federal, state, tribal, university, and NGO partners a synthesis of the current state of ecosystems in the Great Plains relative to climate and other global change stresses, assess the adaptive capacity of the social-ecological systems of the region, and to develop a process for which future assessment can utilize expertise and information on key ecosystem services and sectoral components of the region, including natural and cultural resources. Effective coordination will involve all key programs in the network, including trans-boundary programs. Coordinating programs and other key partners will need to agree on roles and responsibilities essential to supporting regional coordination. To the extent possible, coordination within each region should support the National Climate Assessment, as well as meet other coordination priorities in the region. The research and assessment products will include documentation of the data used in the analysis to reach conclusions, as well as documentation of analytical techniques used.

NORTHWEST

Uncertainty and extreme events in future climate and hydrologic projections for the Pacific Northwest: providing a basis for vulnerability and core/corridor assessments
Principal Investigator(s): **Jeremy Littell**, University of Washington Climate Impacts Group; **Alan Hamlet**, University of Washington Department of Civil and Environmental Engineering; **Nathan Mantua**, University of Washington, School of Aquatic and Fishery Sciences; **Eric Salathe**, University of Washington Bothell Science and Technology Program

Climate information (historical data, downscaled future climate projections, regional climate simulations, hydrologic and ecohydrologic variables) is a key component of prioritizing adaptation actions and conducting vulnerability assessments. However, despite the increasing availability of climate information in the Pacific Northwest and Northern Rockies, a rigorous and physically-based treatment of uncertainty (ranges of projections and sources of model disagreement) in future climate scenarios for the region does not exist. This is particularly true of the extreme climate and weather events that affect aquatic and terrestrial ecosystem vulnerability. This project will leverage existing University of Washington Climate Impacts Group (UW CIG) products and partnerships to develop a comprehensive assessment of the uncertainty in future climate and hydrologic scenarios and their likely impacts on vegetation and aquatic habitat in the Pacific Northwest region, including WA, OR, ID, northwest MT to the continental divide, Northern CA and NV, UT, and the Columbia Basin portion of western WY.

Identification and laboratory validation of temperature tolerance for macroinvertebrates: Developing vulnerability prediction tools

Principal Investigator(s): Robert Black, USGS
Cooperators & Partners: **Susan B. Norton**, National Center of Environmental Assessment, U.S. Environmental Protection Agency; **Bernard W. Sweeney**, Stroud Water Research Center; **Rob Duff**, Washington State Department of Ecology; **Eric D. Fleek**, North Carolina Division of Water Quality; **Peter R. Ode**, California Department of Fish and Game

This project has two primary objectives; to 1) empirically (i.e. statistically) derive thermal tolerance ranges for macroinvertebrates common to national and state monitoring programs, and 2) experimentally determine the tolerance ranges for several (approximately 40) key invertebrate species and compare these values to the empirically derived values. Aquatic insects are a key biomonitoring group because of their dominance in the total biodiversity found in a given habitat and their central role in ecosystem functioning (organic matter processing and food to higher trophic groups). Further, as poikilotherms, insect growth, survival, and persistence at a site is highly temperature dependent. Thus, they are key "sentinel" species to; 1) quantify (described herein), 2) monitor (done routinely nationwide), and 3) predict (product of this proposal) the effects of climate change. By combining a statistical description of critical (and therefore exploitable for prediction) temperature ranges in key species with laboratory testing of the thermal range of that same species, project researchers seek to "add value" to existing biomonitoring programs by developing species specific temperature tolerance values. These values can then be used by scientists and resource managers to predict locations and communities (based on their species assemblages) of greatest vulnerability to changing temperatures.

Range-wide climate vulnerability assessment for threatened bull trout

Principal Investigator(s): **Jason Dunham**, USGS Forest and Rangeland Ecosystem Science Center
Cooperators & Partners: **Stephen Zylstra**, U.S. Fish and Wildlife Service; **Tim Mayer**, U.S. Fish and Wildlife Service; **Doug Peterson**, U.S. Fish and Wildlife Service Abernathy Fish Technology Center

This project aims to integrate new and existing data with expert opinion in a decision support model for assessing contemporary threats and climate vulnerability for threatened bull trout (*Salvelinus confluentus*) across the species' contemporary range in the conterminous United States. Results will include a synthesis document outlining key considerations for developing a climate vulnerability assessment, and the assessment itself, which will include the following: 1) new spatial data and maps of the current distribution of bull trout, their habitats, and threats to these habitats, 2) a synthesis of the most recently available scientific information and expert opinion, and 3) a linked decision support tool (Bayesian network). The assessment will represent a complementary extension of existing efforts to address climate impacts on inland trout and salmon and the coldwater ecosystems they depend on in the western U.S.

Modeling effects of climate change on cheatgrass die-off areas in the Northern Great Basin

Principal Investigator(s): **Bruce K Wylie**, U.S. Geological Survey Earth Resources Observation and Science Center; **Stephen Boyte**, U.S. Geological Survey, Earth Resources Observation and Science Center & SGT, Inc.; **Donald Major**, Bureau of Land Management Idaho and Great Basin Restoration Initiative

Cheatgrass (*Bromus tectorum*) is a dominant invasive species across large areas of the Great Basin. In recent years, the die-off of cheatgrass has been observed across relatively large areas in the region with an estimated 500,000 acres of affected area reported in the general vicinity of Winnemucca, NV. However, actual extent of the phenomenon could be considerably larger as die-offs are occurring in smaller areas across portions of the Northern Great Basin. As part of the BLM's Integrated Cheatgrass Dieoff Project, USGS EROS Center scientists in collaboration with Don Major, BLM Landscape Ecologist, have developed a cheatgrass performance model that incorporates seasonally integrated normalized difference vegetation index (NDVI) from the enhanced Moderate Resolution Imaging Spectroradiometer (eMODIS) along with environmental attributes. Based on the die-off areas in the area surrounding Winnemucca and in the Owyhee Uplands, this project will predict areas of potential cheatgrass die-offs under future climate projections and make climate-based forecasts of these die-off areas.

Climate change threats to fish habitat connectivity: Growth and predation

Principal Investigator(s): **Alec G Maule**, U.S. Geological Survey (USGS) Western Fisheries Research Center, Columbia River Research Laboratory; **Patrick J Connolly**, USGS; **Matthew Mesa,** USGS; **Jill Hardiman,** USGS; **James Hatten,** USGS
Cooperators & Partners: **Michael Newsome**, Bureau of Reclamation; **Jennifer Bountry**, Bureau of Reclamation; **Michelle Schmidt**, National Oceanic and Atmospheric Administration - River Forecast Center; **Karen Jenni**, Insight Decisions, LLC; **Colden Baster**, Idaho State University; **Lee Hatcher**, Methow River Watershed Council

An interdisciplinary USGS team has been working with local stakeholders in the Methow River (a tributary of the Columbia River) in arid eastern Washington State to develop decision support tools with which to evaluate possible climate change effects on natural resources, human economies and Native American cultural values. A stakeholders' workshop was held, which was attended by local politicians; federal, state and NGO resource managers; ranchers/farmers and Tribal representatives. Products from the workshop included stakeholder-defined goals for adapting to climate change. An important aspect of adaptation of aquatic resources in the Methow Basin is the role of habitat connectivity on the ability of native fishes to obtain food. Native fishes participate in feeding both as predators and as prey. With funds from the Great Northern LCC and the Northwest Climate Science Center (NW CSC), we will examine the influence of temperature, habitat availability, and flow under normal conditions and under climate change scenarios to simulate growth and consumption by fish and estimate the potential impact of predation on juvenile ESA-listed salmon. Specific tasks to be completed are: (1) determine if large bodied fish (bull trout, cutthroat trout and mountain whitefish) feeding in the mainstem Columbia River experience increased growth, which increases their predation on juvenile salmon in the Methow River; (2) develop parameters for bioenergetics models for bull trout and mountain whitefish to predict their growth under predicted climate change scenarios; and (3) determine current and potentially available side-channel connectivity, which provides rearing areas and refugia from predation for juvenile fish, in the mainstem Methow River. Thus far, we have (1) collected otoliths from mountain whitefish (our surrogate, non-ESA listed, large-body predator); (2) validated bioenergetics parameters for bull trout; and (3) completed a preliminary on-the-ground assessment of side channels in the Methow. With NW CSC funds we will model possible effects of climate change on fish habitat by completing the side

channel assessment and combining that with existing tributary and mainstem models that predict flow under several climate change scenarios. These predicted changes will be run through an existing fish habitat decision support system to predict changes in habitat.

Toward next generation downscaling for hydrologic prediction in the Pacific Northwest (using Multivariate Adaptive Constructed Analogs – Variable Infiltration)

Principal Investigator(s): **Philip Mote**, Oregon State University; **Dennis Lettenmaier**, University of Washington; **John Abatzoglou**, University of Idaho

A wide range of planning activities, scientific research, and decision support tools require representations of future hydrology at local to regional scales. For example, understanding and predicting wildfire risk, drought, migration of vegetation, invasive species, water quality, agricultural and rangeland productivity, flood control, and many other practical applications require estimates of means and extremes of future streamflow, soil moisture, snowpack, and other hydrologic variables. The state-of-the-art physically based, distributed Variable Infiltration Capacity (VIC) hydrologic model has been widely used for regional climate assessments. In its most commonly used form, the model is forced by gridded daily (or shorter time step) observations of six variables: precipitation, temperature, surface wind, downward solar and longwave radiation, and dew point. Project researchers plan to evaluate the separate but related problems concerning the implications of a) alternative downscaling and bias correction assumptions on hydrologic simulations using the VIC model, and b) the use of climate model output for variables other than precipitation and temperature. Researchers will test alternate approaches to estimating these variables via a new multivariate statistical approach that links them more directly to climate model predictions at the daily time step than has previously been possible. This project will evaluate four different downscaling methods in conjunction with both temperature indexing approaches for estimation of solar and downward longwave radiation and humidity outlined above. The primary focus will be on the Columbia River Basin; however, a broader domain will be considered as well. The downscaling methods include (i) bias correction and spatial downscaling (BCSD); (ii) Multivariate Adaptive Constructed Analogs (MACA); (iii) direct interpolation of RCM output (most likely from the North American Regional Climate Change Assessment Program (NARCCAP); and (iv) bias corrected and interpolated RCM (probably NARCCAP) output.

Contribution of landscape characteristics and vegetation shifts from global climate change to long-term viability of greater sage-grouse

Principal Investigator(s): **Steven T Knick**, U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center; **Sara J Oyler-McCance**, U.S. Geological Survey Fort Collins Science Center

The range-wide distribution of greater sage-grouse (*Centrocercus urophasianus*) may consist primarily of small populations surrounding a few large core populations. The extent to which individuals disperse among breeding populations is important for maintaining genetic diversity and to sustain or recolonize regions experiencing declining population trends. Barriers to dispersal thus can fragment large populations, restrict exchange among small populations, and limit the ability of populations to track shifts in sagebrush land cover predicted in climate change scenarios. This project will use genetic information, obtained from feathers collected at leks (breeding locations), to estimate relatedness among populations and assess gene flow relative to landscape features. The study will identify the characteristics of barriers, including geographic distance, topographic features, anthropogenic land uses (agriculture, transmission corridors, highways and infrastructure), that influence dispersal and genetic

exchange. Researchers will develop the design in the first year that provides a statistically valid sample of the >3,000 leks in the western portion of the sage-grouse range. Subsequent years, pending funding, will be used to conduct the genetic analysis, develop the landscape models of cost-surface, and delineate the features that influence genetic relatedness among sage-grouse populations. Ultimately, this information permits us to estimate population vulnerability to stochastic or environmental risks and will aid managers forced to make difficult decisions about which populations may be more vulnerable due to potential lack of connectivity between other core populations.

Disentangling the effects of climate and landscape change on bird population trends in the Western U.S. and Canada

Principal Investigator(s): **Matthew Betts**, Forest Ecosystems and Society, Oregon State University; **Susan Shirley**, Forest Ecosystems and Society, Oregon State University; **Joan Hagar**, U.S. Geological Survey Forest & Rangeland Ecosystem Science Center

Climate change has been implicated in the range shifts and population declines of many species, but the confounding of climate change with other variables, particularly landscape change, hampers inference about causation. Climate envelope models have been used to predict population trends and future distributions, but the reliability of such predictions remains relatively unknown; without tests of model accuracy, policy development will be based on highly uncertain ground. The research team will assemble recent developments in change detection mapping and species modeling; specifically, our objectives are to: (1) use 32-year data on bird distributions to test the reliability of climate envelope models, (2) test whether changes in climate are linked to bird population declines over the past 32 years and, (3) assess the relative importance of climate versus landscape change in explaining changes in species distributions.

Support to the National Climate Assessment

Principal Investigator(s): **Phil Mote**, Oregon State University

In 2011-12, the National Climate Assessment (NCA) effort encourages regional workshops in each of the defined regions, including the Northwest. Stakeholder engagement has been considered an essential staple of NCA activity and likewise engagement with regional stakeholders from the NW Climate Science Center and the Climate Decision Support Center (CDSC) are having input to the development of their research agenda and priorities. CDSC has been designated as the lead university partner with responsibility for conducting the regional northwest NCA workshop in cooperation with designated federal agencies in the region. The NCA workshop will bring together regional stakeholders that are most interested in understanding regional climate impacts, exploring their climate related problems, and in applying adaptive solutions for their sectors. Beyond mere engagement the workshop also will begin an iterative process of participatory activities and communication about the NCA in the region and as a backdrop to regional assessment processes that also will contribute to the national process as a whole. The planned regional NCA workshop will have two main objectives: 1) convene and launch a process for coordinating the NCA in the northwest region working with Federal agency leads, NW CSC, three regional LCCs, and other relevant stakeholders, including how technical input to the report and NCA will be coordinated; and 2) Outline and initiate development of a regional NCA synthesis for delivery to the NCA by March 2012. Funding will be used to support the workshop and to fund travel for selected stakeholders.

Support for the Second Annual Pacific Northwest Climate Science Center Conference

Principal Investigator(s): **Amy Snover**, University of Washington

The Second Annual Pacific Northwest Climate Science Conference will be held in Seattle September 13-14, 2001 at the University of Washington's Kane Hall. The conference aims to stimulate a place-based (rather than discipline-based) exchange of information about the latest in PNW climate, climate impacts, and climate adaptation research. The conference will also include time for presentation of emerging policy and management goals, objectives, and information needs related to climate impacts and adaptation. The conference will feature cross-cutting plenary sessions covering emerging science and policy efforts of broad interest, more focused concurrent sessions, and plenty of time for discussion and networking, including at an evening poster session/reception.

SOUTHEAST

Integrating the Effects of Global and Local Climate Change on Wildlife in North America

Principal Investigator(s): **Rob Dunn**, North Carolina State University (NCSU); **Steven B Franks**, NCSU; **Nick Haddad**, NCSU; **Nadia Singh**, NCSU

The southeastern United States has experienced large-scale changes in urbanization with consequent effects on local climate. To-date, the impacts of these changes on wild species appear to be overlooked, despite their importance to conservation and wildlife planning. The overarching goal of this project is to model and understand the influence of current urban warming and future global warming on species of conservation concern. This study aims to understand a combination of local mitigation techniques and regional conservation decisions that best facilitate future conservation in the southeastern U.S.

Predicting vulnerability of Southeastern sea turtle nesting beaches to climate change

Principal Investigator(s): Kristen M. Hart, USGS Southeast Ecological Science Center
Cooperators & Partners: **Thomas J. Smith III**, U.S. Geological Survey; **Nathaniel G Plant**, U.S. Geological Survey; **James Watling**, University of Florida

Sea-level rise, increased storm frequency, and altered temperature and humidity associated with climate change may reduce the suitability of nesting and foraging habitats used by federally threatened and endangered species, such as the loggerhead sea turtle. The goal of this project is to produce a vulnerability assessment of coastal habitats representing important nesting grounds for loggerhead and other endangered sea turtles (e.g. Kemp's ridleys, green turtles, and leatherbacks). This project will build upon work already being done to develop vulnerability maps under a number of current and future climate scenarios. These maps will provide management guidance and will serve to identify knowledge and data gaps as primary sources of uncertainty.

Impact of Ocean Warming and Acidification on Growth of Reef-building Corals

Principal Investigator(s): **Ilsa B. Kuffner**, USGS St. Petersburg Coastal and Marine Geology Science Center

Two significant contributing factors to the degradation of coral reef ecosystems are increasing ocean surface temperatures and decreasing ocean acidification. Both factors are related to anthropogenic disturbances of the global carbon cycle. However, there are too few datasets at this time to make educated predictions on the precise impact of these factors. This study aims to identify differences in climate vulnerability among three important reef-building coral species, and subsequently to inform resource management decisions regarding reef restoration and species protection policies. Project goals include a study addressing long-term variability in ocean temperature and acidification and the corresponding response of coral reef development. This data will be used as important baseline information as ocean conditions continue to change.

Developing long-term urbanization scenarios for the Appalachian and Gulf Coastal Plain and Ozarks LCCs as part of the Southeast Regional Assessment Project

Principal Investigator(s): **Jaime Collazo**, USGS North Carolina Cooperative Fish and Wildlife Research Unit

As resource managers work to develop conservation plans that are resilient and robust in the face of future climate change it becomes clear that human impacts on the landscape through urbanization must be assessed and incorporated into planning efforts. Project researchers will develop scenarios depicting urban growth over the next 50-100 years for two Landscape Conservation Cooperatives (LCCs): the Appalachian Landscape Conservation Cooperative (App-LCC) and the Gulf Coastal Plains and Ozarks LCC (GCPO-LCC). The study will use the modified version of the USGS SLEUTH model that allows for rapid calibration and simulation of urban growth patterns as well as multi-scenario development with stakeholders and end-users. Using a process and methodology established for the USGS Southeast Regional Assessment Project (SERAP) two questions will be addressed: (1) What is the extent of projected urban growth over the next 50-100 years for these two LCCs given current urbanization rates in this region? and (2) What are the potential impacts of this urbanization on habitats and potential habitat corridors?

Southeast Regional Assessment Project (SERAP) (Continued 2009 Project)

Principal Investigator(s): **Adam Terando**, North Carolina State University

The Southeast Regional Assessment Project (SERAP) seeks to formally integrate multidisciplinary project components to aid conservation planning and design so that ecosystem management decisions can be optimized for providing desirable outcomes across a range of species and environments. SERAP will provide a suite of regional climate, watershed, and landscape-change analyses and develop the interdisciplinary framework required for the biological planning phases of adaptive management and strategic conservation. There are 4 main SERAP components:

- Developing Regionally Downscaled Probabilistic Climate Change Projections*;*
- Integrated Coastal Assessment*;*
- Integrated Terrestrial Assessment*;* and

- Multi-Resolution Assessment of Potential Climate Change Effects on Biological Resources: Aquatic and Hydrologic Dynamics,

These components produce data and other outputs that are compiled and used in the development of a fifth component:

- Optimal Conservation Strategies to Cope with Climate Change, a tool for resource managers to ensure the most effective land management strategies.

USFS-USGS Climate Change Project (funded through the NCCWSC)

Principal Investigator(s): **W. Brian Hughes**, USGS Georgia Water Science Center; **C. Andrew Dolloff**, U.S. Forest Service, Southern Research Station

Collaborators & Partners: **James T. Peterson**, USGS Oregon Cooperative Research Unit; **Mary C Freeman**, USGS Patuxent Wildlife Research Center; **Lauren E Hay**, USGS National Research Program; **Jacob H LaFontaine**, USGS Georgia Water Science Center; **Carolyn M. Elliot**, USGS Columbia Environmental Research Center; **Robert B Jacobson**, USGS Columbia Environmental Research Center; **Paul L Angermeier**, USGS Virginia Cooperative Research Unit; **Emmanuel A. Frimpong**, Virginia Tech, Fish and Wildlife Conservation; **James M. Vose**, U.S. Forest Service Coweeta Hydrologic Laboratory

The Southeastern U.S. spans broad ranges of physiographic settings and contains a wide variety of aquatic systems that provide habitat for hundreds of endemic aquatic species that pose interesting challenges and opportunities for managers of aquatic resources, particularly in the face of climate change. For example, the Southeast contains the southernmost populations of the eastern brook trout and other coldwater dependent species. Climate change is predicted to increase temperatures in the south and is likely to have a substantial effect on extant populations of coldwater biota. Thus, aquatic managers are tasked with developing strategies for preserving coldwater dependent biota, such as eastern brook trout, and for providing new conservation opportunities in ecosystems that will be transitioning from cold or cool-water ecosystems to warmwater ecosystems. This is a joint-project with the U.S. Forest Service to develop integrated tools that allow natural resource managers to develop and evaluate strategies for minimizing the effect of climate change on aquatic ecosystems and related ecosystem services. There are two concurrent studies, one in the Pacific Northwest addressing the effects of potential temperature and flow fluctuations due to climate change on salmon, trout, and chars and this project, in the Southeast, that is focused on climate change effects on cold-water species and ecosystem services.

SOUTHWEST

Climate change impacts in the Southwest: An assessment of next generation climate models for making projections and derivations

Principal Investigator(s): **Mark Schwartz**, University of California, Davis; John Muir Institute of the Environment; **Dan Cayan**, Scripps Institution of Oceanography, University of California, San Diego; U.S. Geological Survey National Research Program; **Sasha Gershunov**, Scripps Institution of Oceanography, University of California, San Diego; U.S. Geological Survey National Research Program; **Mike Dettinger**, Scripps Institution of Oceanography, University of California, San Diego; U.S. Geological Survey National Research Program; **Alex Hall**, University of California, Los Angeles

In this initial project researchers will: (a) archive the relevant AR5 model output data for the southwest region; (b) downscale daily temperature and precipitation to 12 X 12 km cell spatial resolution over the Southwest; (c) assess the precision (degree of agreement) of the simulated models; (d) assess the direction and magnitude of change in projections between AR4 and AR5, as well as assess projections of key extreme climatic events (i.e., extreme drought, extreme seasonal precipitation, extreme high and low temperature events); and (e) assess critical ecosystem impacts (i.e., climate water deficit and fire; hydrological condition of major river systems; impacts on highly valued species).

Climate Assessment, Adaptation Synthesis and Research Needs for the Southwest

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The goals of this project are to: (a) produce a state-of-the-art assessment and synthesis of climate change projections, impacts, vulnerabilities, adaptive capacity, and prospects for mitigation and adaptation actions in the Southwest in support of the regional contribution to the National Climate Assessment; (b) develop an inventory of federal partners and stakeholders involved with climate adaptation programs; and (c) forge stronger bonds between the DOI-SWCSC, the three NOAA-RISAs in the Southwest, and the Landscape Conservation Cooperatives.